THE BINARY β 395 = 82 CETI.—Dr. T. J. J. See has found a most interesting double system in the binary β 395, which Burnham was the first to detect (1875) and the last to measure (1891·8). The object was detected with Dr. See's usual sweeping power, namely 500, but before the components could be well divided he had to employ a power of 1500. At first the system was supposed to be new, owing to the great difficulty of observing it, but a search showed that it was none other than the system mentioned above, its cordinates being

$$\alpha = 0\text{h. } 32\text{m. } 9{\cdot}9\text{s. } \delta = -25^\circ\ 18'\ 37''{\cdot}3\ (1900{\cdot}0).$$

The most striking feature of this binary is that since its last measurement the orbital motion has been so great that the whole aspect of the system is changed. Nearly one and a half revolutions have been performed since 1875, and, curiously enough, as the companion returned to the same general position in 1886, the "observers of that and the following years failed to recognise that any sensible motion had intervened."

Dr. See has calculated from all the published observations the orbit of this binary (*Astr. Nachr.*, No. 3455), and he finds it of great eccentricity and revolving in the short period of 16·3 years.

Thus 82 Ceti becomes an important system, and should be carefully watched during the next eight years. Only three other systems revolve more rapidly, namely, β 883 in 5·5 years, κ Pegasi in 11·42, and δ Equulei in 11·45 years.

TELESCOPIC SEEING.—The Lowell Observatory is not of a fixed but of a migratory nature. Like a bird which at some period of the year changes its locality for warmer climes, so this observatory is moved to a region where the air is more suited at that time for better telescopic seeing. Oscillating between Flagstaff, Arizona, and Tacubaya, Mexico, Mr. Lowell is able to take advantage of the periods of good seeing at each of these stations. Both localities satisfy the now well-known geographical and meteorological conditions, and while Flagstaff is rather too far north, bordering on the great cyclonic movement in the north temperate zone in winter, the neighbourhood of the city of Mexico is not affected by this disturbance. The latter station is not, however, found to be ideal, owing to conditions of local topography. What these conditions are will be found stated by Mr. Lowell in his discussion on the capabilities of these two stations (*The Observatory* for November, No. 259).

The well-known observer, Dawes, always used to judge the "goodness" of the night by the size of aperture that could be satisfactorily used; thus he would speak of a one-inch night, three-inch night, up to an eight-inch night, his largest aperture being of eight inches. We are now finding out how accurate this system was, for, owing chiefly to the work of Mr. Douglass, the controversy between large and small apertures seems to be a question of the wave-lengths of the air-waves. An idea of the nature of these small air-waves will be gathered from Dr. See's interesting article in the *Astronomische Nachrichten* (No. 3455), and the diagrams shown illustrate the main conditions for good and bad seeing. These waves vary in different currents from half an inch to several feet. In cases where they move in the same direction and at a great rate the seeing is very bad. With moderate-sized waves moving slowly the definition is generally very fair. Often cross-currents occur, and when fine waves move in all directions the definition is never good, but for cases of very fine seeing only very slight traces of gently moving waves can be discerned. Theoretically for the best seeing there should be no trace of movement at all. Dr. See points out, in another article in the same journal, that the scintillation of the fixed stars can be very easily explained on this wave theory, and the experiments which he has carried out tend to corroborate this view.

THE NOVEMBER METEORS.—At the latter end of this week the earth passes through that stream of meteors which gives us a yearly display on about the 14th of this month. Mr. Denning, who is our chief authority on this subject, and whose admirable memoir on this special swarm should be carefully absorbed, tells us that the morning hours of the 14th should be more especially devoted to their observation, although watches should be commenced a day beforehand and prolonged until the 16th. It is not, however, until the year 1898 that we expect to meet the most dense parts of the swarm, but on former occasions striking displays have been witnessed a year or two previous to the chief one, and this year we hope will be no exception. Let us trust that the weather will not be so unfavourable as it was last November.

THE CONNECTION BETWEEN THE CHARACTERS OF ISOMORPHOUS SALTS AND THE ATOMIC WEIGHT OF THE METALS CONTAINED.

IN order to assist in elucidating the question of the relationship between the chemical composition of solid substances and the nature of the crystals which they are observed to form, both as regards the exterior geometrical configuration and the interior physical character of such crystals, a series of researches were commenced by the author six years ago, having for their immediate object the exact determination of the differences presented by certain well-defined series of isomorphous salts. The differences in question, due to the different nature of the interchangeable chemical elements, belonging to the same family group, which by their mutual replacement give rise to the series, are so small in the case of the morphological constants, that extremely refined methods of investigation are requisite in order to detect and determine them. A large amount of detached data had previously been accumulated in crystallographic literature, but a very small proportion was characterised by the requisite degree of accuracy, and no organised attempt had hitherto been made to investigate any definitely related series of crystallised compounds in a sufficiently detailed and accurate manner. The care and precision demanded will be at once apparent when it is pointed out that the use of slightly impure or imperfect crystals, or the occurrence of slight errors of orientation in grinding out of the crystals the section-plates or prisms requisite for the optical portion of the work, would be sufficient to render the results valueless for the purpose in view. In fact such sources of error have in certain cases been shown by the author during the progress of the work to have led previous observers to conclusions diametrically opposed to the truth.

It was decided to choose, as most suitable for such a study, certain series containing in their different members the three alkali metals potassium, rubidium, and cæsium, on account of the very definite relationship and considerable intervals between their atomic weights, and the extreme electro-positive nature of the group, which latter fact rendered it likely that the differences in question would be here at a maximum. These three metals belong in the strictest sense to the same family group, and their atomic weights are respectively 39, 85·2, and 132·8, the atomic weight of rubidium being thus almost exactly the mean of the values for potassium and cæsium. The particular salts chosen, on account of the general excellence of their crystals, were the normal sulphates and selenates, and the double sulphates and double selenates which these salts form with the sulphates and selenates of magnesium, zinc, iron, manganese, nickel, cobalt, copper, and cadmium. The work on the sulphates, double sulphates, and selenates has at length been completed and presented to the Chemical Society (*Journ. Chem. Soc.*, 1893, 337; 1894, 628; 1896, 344; 1897, 846), and the investigation of the double selenates is now in hand. The choice of the double salts has proved equally as fortunate as that of the simple salts, inasmuch as the influence of the alkali metal is found to be of a vastly preponderating character compared with that of the dyad metal, and hence the eight groups of these salts have furnished so many independent examples of the influence of the atomic weight of the alkali metal. No effort or expense has been spared to render the work absolutely trustworthy and of a final character. The goniometers and other optical instruments employed have been without exception the most accurate that could be constructed, and the observations have been more numerously repeated upon different crystals than has ever before been attempted. Moreover, great care has been bestowed upon the preparation of perfectly pure specimens of the salts, no material being accepted which did not yield absolutely satisfactory results upon both spectroscopic and ordinary gravimetric analysis. Besides goniometrical and optical investigation, the work has included exceptionally careful determinations of the relative density of the salts in the crystallised condition, in order to afford data for the calculation of the volume relationships and of the molecular optical constants. Moreover, the observations have been extended to other than the ordinary temperatures, in order that the deductions shall not be subject to the objection that they may be simply fortuitous for a particular temperature.

Before commencing the optical part of the work attention was concentrated upon devising an instrument which should enable a section-plate (slice), or a 60° prism, to be ground out of a crystal with precisely such an orientation as might be desired, with respect to the natural faces, and therefore to the morphological axes. For the whole of the optical investigation is carried out by means of such plates and prisms of known orientation, the former being requisite for the establishment of the positions of the principal optical planes, the measurement of the optic axial angle, and the study of the interference phenomena, while the latter are essential for the determination of the three refractive indices. Manifestly, therefore, the accuracy of the optical results depends primarily upon the precision with which the desired orientation of these plates and prisms is attained. Hitherto crystallographers who have investigated the optical properties of the crystals of laboratory preparations, which are so much softer and more friable than mineral crystals, have been content either to employ plates or prisms formed by suitably disposed natural faces of the crystals themselves; or, failing such, to prepare them by grinding the crystals in oil upon a ground-glass plate, the crystal being held between the finger and thumb during the process. The difficulty of thus obtaining a plane surface having the desired orientation must be at once apparent, to say nothing of the imminent risk of breaking the crystal. At the best such a method can only be approximate, and it is attended with so much that is troublesome and vexatious that the investigation of a large series of compounds, in the detailed and accurate manner which the author desired, would be impossible.

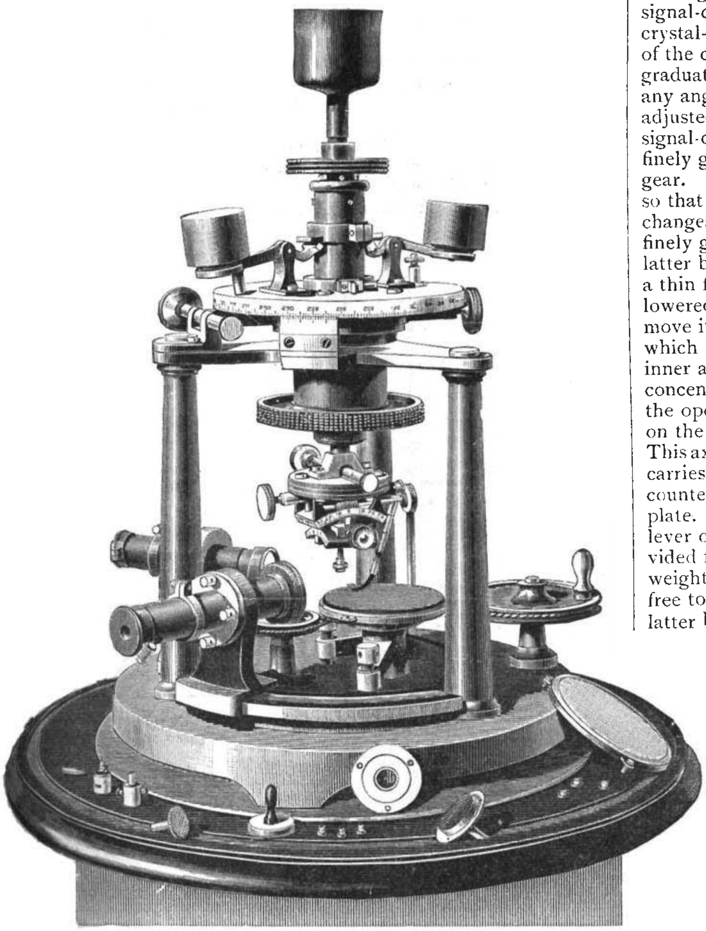

FIG. 1.

After much consideration an instrument was eventually devised, and constructed for the author by Messrs. Troughton and Simms, which achieves the desired object in a most satisfactory manner. The author has no hesitation in ascribing the success which has attended the investigation to the admirable manner in which this instrument performs its functions. More than five hundred plates and prisms have already been prepared by its aid and employed in the work; and never once, for instance, has a plate which was desired to be perpendicular to the acute bisectrix of the optic axes failed to exhibit the interference figure by convergent polarised light precisely symmetrical to the centre of the field, as it should be. Moreover, not more than half a dozen crystals have been broken during grinding, and absolutely no plates or prisms have required to be rejected on account of want of accuracy of orientation. Further, what was by the old method a most tedious and disagreeable part of crystallographical work, now becomes one of the most delightful and interesting.

The instrument will be found fully described in the *Transactions* of the Royal Society (1894, A, 887), but a few words here as to the principles of its construction may not be without interest. It is represented, by the kind permission of the Royal Society, in Fig. 1. It may be succinctly termed a grinding goniometer, for it combines an accurate, suspended, horizontal-circle goniometer with a grinding apparatus. The telescope and signal-collimator, together with the circle and the suspended crystal-adjusting apparatus, form the goniometer. The segments of the circular movements of the adjusting apparatus carry finely graduated silver arcs, in order to enable the crystal to be set at any angular position, with respect to any zone of faces previously adjusted parallel to the axis with the aid of the telescope and signal-collimator. The grinding apparatus consists of a small finely ground glass disc, capable of being rotated by hand driving gear. By a simple device the latter is made almost frictionless, so that the disc is rotated almost without effort. Three interchangeable discs are provided, the second being of extremely finely ground glass, and the third of polished glass, these two latter being employed for polishing; all are used lubricated with a thin film of oil. The axis of the instrument is capable of being lowered or raised, so as to bring the crystal to the grinder or remove it, by means of a large milled-headed nut near the summit, which engages with a screw thread on the upper part of the inner axis. In addition to this, however, there is another outer concentric axis capable of vertical movement, intended to enable the operator to regulate the pressure with which the crystal bears on the grinding surface, in order to avoid breaking the crystal. This axis slides in the cylindrical bore of the rotatable cone which carries the circle, and it is capable of being fully or partially counterpoised by two weighted levers carried above the circle plate. It is usually found most convenient to throw the back lever out of gear during the grinding, by raising a screw provided for the purpose on the circle plate, thus leaving half the weight of the axis to bear downwards when the front lever is free to act, and then to more or less curtail the freedom of the latter by gentle manipulation with the left hand, while the right hand is used to rotate the driving pulley of the grinding gear. After a little practice the pressure is nicely regulated almost involuntarily by the left hand in accordance with the "feel" of the grinding, rendering it most unusual to crush the crystal operated upon.

Continuous use of this instrument has proved it to be all that can be desired for use with the crystals of chemical preparations. A somewhat larger instrument has since been constructed for the author, and was described in the *Proceedings* of the Royal Society (57, 324), for use either with chemical preparations or with the harder crystals of minerals; this instrument includes an independent diamond-fed cutting apparatus, and a large selection of metallic and other grinding and polishing laps, so that plates or prisms of even the hardest natural gems can be cut and subsequently ground and polished in an equally satisfactory manner. A duplicate of this instrument is included in the National Collection in the South Kensington Museum.

A further original piece of apparatus, which the author has also found invaluable in the optical part of the work, is a spectroscopic monochromatic illuminator, a description of which will be found in the *Transactions* of the Royal Society (1894, A, 913). It has enabled the author to make observations in every case for six wave-lengths at suitable intervals in the spectrum, and has proved particularly useful inasmuch as each of the series of salts investigated has included at least one member which exhibited exceptional optical properties, generally involving crossed axial plane dispersion of the optic axes, in which instances the command of an illuminator which could be made to yield light of any desired wave-length enabled the phenomena to be studied with a completeness hitherto unattainable. In brief, the apparatus is a spectroscope with two collimators, the slit of the first being as usual for the entrance of the rays from the source of light, in the author's case the electric arc, while the slit of the second is employed as a selecting slit as in Captain Abney's well-known apparatus. The two optical tubes, however, remain fixed, while the dispersing apparatus, a single large prism of high dispersion, is made to rotate so as to bring the various parts of the spectrum across the selecting slit in turn. The selected ray issuing from the second slit is slightly diffused by a screen of finely ground glass carried in a short sliding tube in front of the slit, which is all that is required in order to flood the whole field of any of the author's observing instruments, such as goniometers, polariscopes, and microscopes, with evenly distributed monochromatic light. The accompanying illustration, Fig. 2, shows, by the kind permission of the Chemical Society, the arrangement as actually used with the gonio-spectrometer in the determination of the refractive indices.

Having thus described the difficulties of the investigation and the measures taken to overcome them, a brief outline of the results attained up to the present will now be given.

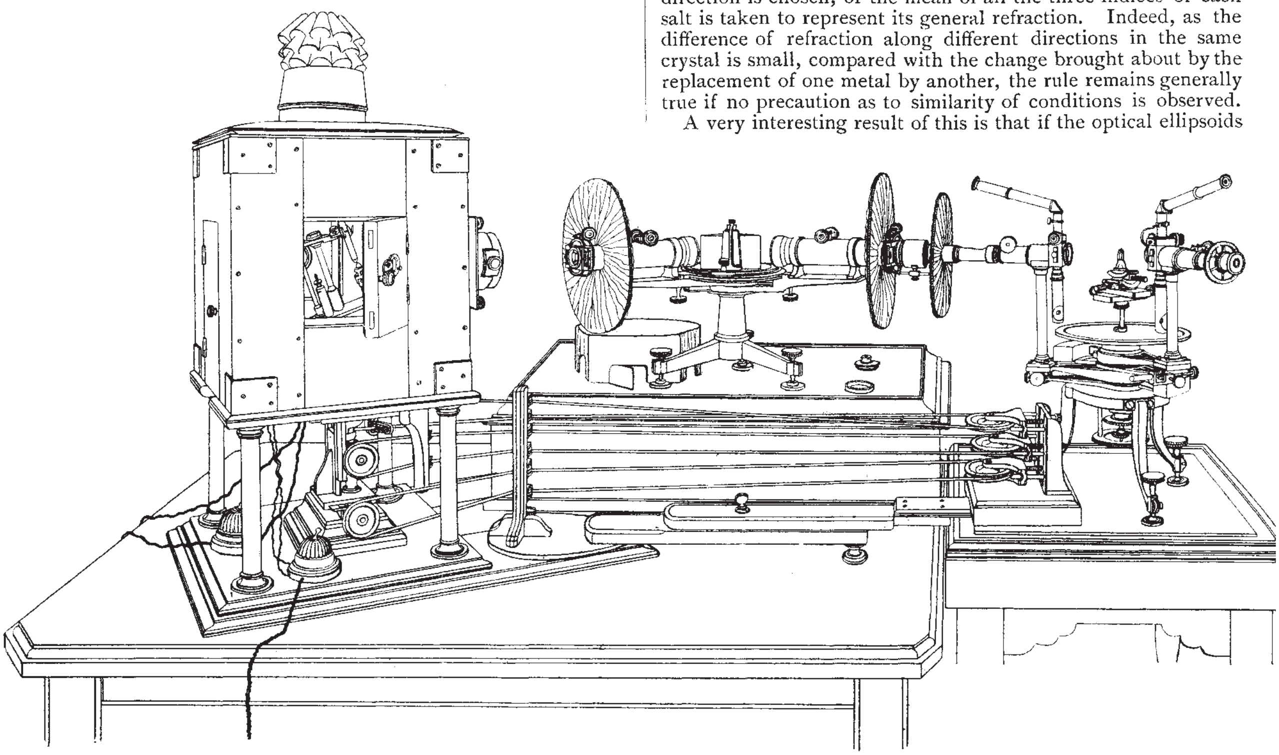
FIG. 2.

The use of the term "isomorphous" is not strictly correct, except in the cases of such series as crystallise in the primary forms of the cubic system, in which, for geometrical reasons, the interfacial angles are always identical. The normal sulphates and selenates of the three alkali metals under consideration crystallise, anhydrous, in the rhombic system, and the double salts of the series $R_2M(SO_4)_2 \cdot 6H_2O$ in the monoclinic. The same planes are common to all the six simple salts, the replacement of sulphur by its family analogue selenium not effecting any change in this respect; likewise the double sulphates are characterised by planes common to their series. But corresponding interfacial angles on the different members of the same series are not identical, but differ by amounts varying from a few minutes to a couple of degrees. They are much smaller in the simple salt series than in the double salts. The result of elaborate measurements has revealed the fact that, without a single exception, the values of the angles of any rubidium salt are intermediate between those for the corresponding potassium and cæsium salts. There is consequently a progression in the angles of inclination of the crystal faces following the order of progression of the atomic weights of the alkali metals. Moreover, as a natural corollary, there is a corresponding progression in the morphological constants, the axial ratios. Still further, the influence of the nature of the metallic atoms is observed to exercise a curious effect upon the prevailing habits of the crystals. For example, the sulphates and selenates of potassium exhibit preponderating development of the brachypinacoid, the crystals usually being tabular in this direction; on the other hand the cæsium salts are characterised by the prominence of the basal plane, while the rubidium salts are distinguished by a prismatic habit due to the predominance of a brachydomal form intermediate between the two planes just mentioned.

Turning now to the optical properties, it has been found to be a rule without exception that the refractive indices of any rubidium salt are intermediate between those of the corresponding potassium and cæsium salts, and nearer to the former than to the latter, the differences being as one to three. In accordance with the biaxial character of the crystals, each salt has three refractive indices corresponding to the different degrees of facility for the transmission of light along the three rectangular directions of the axes of the optical ellipsoid. In making the comparison, the same result is obtained whether the same direction is chosen, or the mean of all the three indices of each salt is taken to represent its general refraction. Indeed, as the difference of refraction along different directions in the same crystal is small, compared with the change brought about by the replacement of one metal by another, the rule remains generally true if no precaution as to similarity of conditions is observed.

A very interesting result of this is that if the optical ellipsoids of the three rhombic sulphates or selenates are constructed, from the refraction data, about the same origin, using rectangular axial coordinates, which correspond to the mutually identical axes of morphological and optical symmetry, they are found to envelop each other; supposing the ellipsoid to be the optical indicatrix of Fletcher (the optical reference surface now universally employed), the indicatrix for the cæsium salt is the outer one, and that for the potassium salt the innermost, while that corresponding to the rubidium salt lies between the two, without touching either, but nearer to the innermost. In the double sulphate series the indicatrix likewise expands as the atomic weight of the alkali metal rises, but monoclinic symmetry only demands that one of the axes of the indicatrix shall be identical with the single symmetry axis of the system, the other two rectangular axes of the indicatrix being free to move together in the symmetry plane. The expansion of the indicatrix when potassium is replaced by rubidium or the latter by cæsium, is actually found to be accompanied by a rotation for several degrees about the symmetry axis, and the amount of this interesting rotation is more than twice as much for the latter chemical change as it is for the former.

The double refraction is also progressively affected by the replacement of potassium by rubidium and the latter by cæsium, the amount varying inversely as the atomic weight of the metal. Some very remarkable phenomena follow from this rule, owing to the fact that the initial amount of the double refraction in the potassium salt of any series or group is already very small. For a comparatively slight diminution is sufficient to bring it to zero, and even to go further and reverse its sign. As the three refractive indices of any salt are not equidistant from each other in value, and are affected to different extents by the same chemical change, they never in either the rubidium or cæsium salts become reduced to absolute identity at the same time, but become equal in pairs for specific wave-lengths of light and degrees of temperature. When this occurs the crystal becomes for that wave-length and temperature temporarily uniaxial in its optical comportment. The particular salt in which this occurs varies in the different series. In the sulphates it is the rubidium salt, in the selenates the cæsium salt, both at temperatures slightly elevated above the ordinary; in the double sulphates it occurs in cæsium magnesium sulphate and at the ordinary temperature for blue light, while in the other groups of this series the progression never quite reaches the state of equality of two indices. It will be evident that the distribution of the directions corresponding to the α, β and γ indices, and also the optic axial phenomena in convergent polarised light, vary in the three salts of each series or group to a quite extraordinary extent; so much so that without the discovery of this rule, which affords the key to them, the vagaries must have been incomprehensible. For whenever two indices become identical the third is also very nearly so, and consequently the slightest change of wave-length or temperature brings about most drastic changes in the optical phenomena dependent upon the mutual relations of the three. The most striking case is that of cæsium selenate. At the ordinary temperature the sign of double refraction and disposition of the optic axes are already reversed from what they were in potassium and rubidium selenates, and the three indices are so nearly identical that a section plate a centimetre thick is necessary to produce an interference figure in convergent polarised light. On heating gradually to 250°, the sign of double refraction changes twice over, and the optic axes move so rapidly that their acute bisectrix occupies the direction of each of the three morphological axes in turn. That these remarkable phenomena are precisely what are demanded by the rule of progression above enunciated, given the initial optical conditions of the potassium salt, is perhaps the most striking proof of the validity of the rule.

It may be here mentioned that double sulphates of potassium and manganese, and potassium and cadmium, containing six molecules of water, have not yet been obtained, although the corresponding rubidium and cæsium salts are readily formed; yet from the above rule, and others which have been indicated for the other properties, the author has been able to predict the morphological and optical constants which these salts will probably exhibit if ever they are obtained.

The determination of the densities of the crystallised salts has enabled the molecular optical constants to be calculated, with the aid of the formulæ of Lorenz and of Gladstone and Dale. It has been found that they exhibit a similar progressive increase following the increase in the atomic weight of the alkali metal, and that the increase is always greater when cæsium replaces rubidium than when the latter replaces potassium. The molecular refraction for the crystallised state of the sulphates and selenates was also compared with that for the state of solution in water, specific determinations of the density and refraction of highly concentrated solutions of known strength being made for the purpose. It was found that while the values for the two states are approximately the same, there are slight differences, due to the change of state, which observe a distinct progression; for they vary directly as the specific refractive energy and inversely as the atomic weight of the alkali metal. In both series the refraction equivalent of the potassium salt rises by 2½ per cent. when the salt is dissolved in water, and that of the rubidium salt by 1 per cent., while that of the cæsium salt decreases by ½ per cent. This interesting order of the differences clearly demonstrates the quantitative influence of the nature of the alkali metal upon even the smallest details of the physical properties; and the fact that the sign of the differences passes during the progress from positive to negative, indicates the substantial accuracy of the principle enunciated by Dr. Gladstone in 1868 that "the refraction equivalent of a solution is the sum of the refraction equivalents of the solvent and the substance dissolved," by the application of which principle the calculations for the state of solution were made.

The molecular volumes of the members of each series likewise exhibit the order of the atomic weights of the alkali metals, but the progression again proceeds more rapidly than in simple arithmetical proportion to the latter. A point of particular interest was elicited with respect to the volumes of the double sulphates, which throws a strong light upon the nature of those salts. It was found that the volume of the alkali sulphate is the same in the double salt as it is for the simple salt itself, that is to say, the simple alkali sulphate enters into the structure of the double salt without suffering any contraction in volume. This fact, contrasted with the very large contraction which accompanies the chemical union of the elementary constituents of the simple sulphates, negatives the possibility of chemical combination of the molecular constituents of the double salts. This, together with other facts which the investigation has brought to light, has led to the important conclusion that the composition of these double salts is simply a result of the aggregation of the molecular constituents in a particular type of homogeneous structure, in which they find stablest equilibrium, the very nature of this structure ensuring that the component simple molecules are always present in the same, the observed, proportion. The elucidation and definition of all the possible types of homogeneous structures have recently been elaborately worked out by Federow on the continent, and Barlow in this country, and the precise correspondence between the possible types of homogeneous structures and the observed varieties of crystal symmetry is now established beyond all doubt. The author has been able to indicate, moreover, the particular member of Barlow's classification corresponding to both the simple and double salt series.

The conclusion just referred to, regarding the nature of the double sulphates, taken in connection with other facts which the author has established, leads to a further one of a still more far-reaching character, namely, that the units of a homogeneous crystal structure are the simple chemical molecules themselves, and that the current assumption that the crystal unit is a more or less complex aggregation of chemical molecules is quite unnecessary and in general erroneous. This conclusion is further strongly supported by some recent work of Fock, on the solubilities of mixed crystals, based upon the theory of solid solutions.

Before leaving this interesting subject it should be mentioned that a method has been found, by combining the molecular volume with the morphological axial ratios, of determining the relative distances apart of the centres of contiguous chemical molecules of the sulphates and selenates, and of contiguous groups of the eight component chemical molecules of the double sulphates, each such group corresponding to the generic formula $R_2SO_4.MSO_4.6H_2O$. A comparison of these "distance ratios" shows that the replacement of potassium by rubidium, and of the latter by cæsium, is accompanied by a progressive increase in the separation of the structural units or groups of units in every direction, corresponding to the progress of the atomic weight of the alkali metal, and that the latter replacement always gives rise to a greater extension of the structure than the former.

In conclusion, the net result of the investigation has been to show that the whole of the morphological and physical properties of the crystals of each of these isomorphous series exhibit progressive variations, which follow the order of progression of the atomic weights of the alkali metals which the salts contain. Hence it may be said that these variations are functions of the atomic weight of the alkali metal, and it has been shown that the function is usually one which involves higher powers than the first. Of course atomic weight is only one of the numerous properties of an element, but it is doubtless the most convenient reference constant that could be chosen to express fundamentally the difference in the essential nature of the atoms of different elements. It is this difference in essential nature which gives rise to the rules which have been brought to light by the investigation; and the author desires to make it quite clear that atomic weight is merely employed as the basis of reference because it is the aptest expression of such difference, and not because of any virtue in atomic weight *per se*. The fact that the rules are equally applicable to series so widely different as the rhombic sulphates and selenates and the monoclinic double salts, appears to indicate their application to isomorphous series in general. Hence the author concluded his last communication to the Chemical Society in the following words: "The difference in the nature of the elements of the same family group which is manifested in their regularly varying atomic weights, is also expressed in the similarly regular variation of the characters of the crystals of an isomorphous series of salts of which these elements are the interchangeable constituents."

A. E. TUTTON.

THE JACKSON-HARMSWORTH ARCTIC EXPEDITION.

THE first meeting of the present session of the Royal Geographical Society took place at the Queen's Hall, Langham Place, on Monday night last, when Mr. Frederick G. Jackson lectured on the expedition led by himself to the Arctic regions. For the following abridged account of the lecture we are indebted to the *Times*:—

It was in August 1873 that the land afterwards known as Franz Josef Land was first accidentally discovered by the Austro-Hungarian expedition, under the leadership of Weyprecht and Payer. The following spring Payer made three journeys up and in the neighbourhood of what he then named Austria Sound. Arctic authorities advocated the route to the north suggested by Payer's impression that there was land still further to the north in and beyond the eighty-third degree, and land to the north-west reaching almost as far, and it was on Payer's observations that Mr. Jackson formulated his plans in the latter end of 1892. Unfortunately his expectations were fated to disappointment by the non-extension of the land to the north. His plans embraced not only an advance in a northerly direction, but the mapping-in of the coast-lines of Franz Josef Land, a thorough examination of that country, in taking scientific observations, and making collections generally. Those plans they had been able to carry out; and scientific observations had been carried on uninterruptedly for three years. They had also practically completed the map of Franz Josef Land, and settled the Gillis Land question. For some time the sinews of war were conspicuous by their absence, and little encouragement was given, but eventually Mr. Alfred Harmsworth generously offered to provide the necessary funds for the proposed expedition. They left the Thames on July 12, 1894, in the steam yacht *Windward*, calling at Archangel. Then they proceeded east, skirting the northern shores of Kolguev Island to Kharborova, a Samoyed settlement on the Yugor Straits, to take on board their thirty dogs and some fresh reindeer meat. They then steamed north through the Barents Sea, making for Bell Island, Franz Josef Land. The mass of islands of which Franz Josef Land was comprised consisted of high glacier-land rising to 2000 feet, covered with an ice-cap some hundreds of feet in thickness, and fronted along the shore by high perpendicular glacier faces from 30 feet to 80 feet in height.. At rare intervals high black basaltic rocks jutted out of the ice near the shore, forming the only conspicuous landmarks. In front of these rocks the broken-down débris from the cliffs had formed a plateau, or shore, upon which a certain amount of stunted Arctic vegetation existed. Here might be found a few poppies, saxifrages, mosses, lichens, &c. Everywhere else, with the exception of a few low islands, the ice-sheet overran everything. Thick mists generally overhung this land; violent gales were frequent, combined with heavily falling and driving snow. Finding no suitable site for their hut, they returned to Cape Flora, a high basaltic cape 1400 feet high, beneath which they pitched their camp, as being the most favourable spot they had yet seen, one of the strongest inducements being the presence of a large loomery there in the high rocks, and the known presence of bears and walruses throughout the year. This they reached on September 8. They at once set to work to shoot bears and walruses for the winter, and to put up their log hut, which was named "Elmwood," and to make themselves as comfortable as circumstances would allow. On the return of the sun, about the middle of February, they got ready to start, and on March 9 Mr. Armitage and he took a preliminary journey with the object of making a depôt of provisions to the north and of ascertaining the character of the travelling in that direction. In the beginning of April they got under way with three ponies and a number of sledges, being accompanied for the first week by Dr. Koettlitz and young Hayward with one pony and sledges. Soon after rounding Dundee Point they discovered that the existing maps were not quite in accordance with fact. To the northward lay floe ice where land had been mapped in; and it was not till they reached the latitude of Point Arthur that they could discern land to the westward. To the south-west appeared open ocean. The weather now became very bad, and they were frequently confined to their tent for days together. Constant gales and driving snow impeded their advance, and the floe ice itself became very unstable with water in the deeper layers of the snow, so that they were frequently wading about in slush above their knees. They, however, pushed on. Richthofen Peak could nowhere be discerned, and no hill worthy of the name of mountain could be seen in any direction, although they were within half a mile of its supposed site. On April 30 they rounded Cape Fisher, and to the north appeared a low island, which in the distance had rather a volcanic appearance, owing to a cup-shaped elevation upon it. On May 1 they rounded Cape M'Clintock, a low weathered cape of columnar basalt, projecting out of the ice-clad land behind. A striking feature of this rock was a pillar of columnar basalt standing up in front of it. Thus it was in April 1895 that they discovered the Queen Victoria Sea, which he named after her Majesty. They reached a point 81° 20′ N. They carefully mapped in the whole coast-line, although the weather was exceedingly unsuitable for taking bearings. On May 4 they started back in a strong wind, dense mist, and driving snow, returning by the same route as they had come up. The difficulties of the floes daily increased. They had constantly to haul the ponies out of the snow morasses with ropes round their necks. They would then go for a few yards further and would flounder in again. They frequently had to take the sledges on themselves, leading the ponies through especially bad places, and had to go over the same ground thirteen times to effect this. On their return journey they got a view of the land to the north-west, which appeared to consist of islands. They returned again round the cape that he had named Cape Richthofen, thus giving themselves an opportunity of discovering the whereabouts of Richthofen Peak, if such existed; but they again failed to see any sign of such a hill in any direction. On May 12 they reached their hut at Cape Flora, getting the ponies back in the nick of time. After their return they were busy with botanical, geological, and other examinations, and in fitting up their whaleboat, the *Mary Harmsworth*, for a journey round the south-west coast as soon as the *Windward* should break loose from her winter quarters and depart for home. This she did on July 3, after being cut out of the ice. To the southward there appeared to be little ice, and from an altitude of over 1400 feet little more than open sea could be discerned. The other expeditions made by Mr. Jackson during his stay were described, and the lecturer concluded by saying that, so far from viewing Franz Josef Land as a favourable route to the Pole, his experiences now led him to believe it to be one of the worst; and although he had, in common with other Arctic explorers, the greatest desire to stand upon that mathematical point, still he had no sympathy with an attempt to reach the Pole as a mere athletic feat alone, but considered that geographical and other scientific work should always be included in the plan.

REPORT ON TECHNOLOGICAL EXAMINATIONS.

THE report on the work of the Examinations Department of the City and Guilds of London Institute for the session 1896-97 has just reached us, and is as usual a very business-like and interesting publication. We make a few extracts from it.

There has been a marked development in the work of the Examinations Department of the Institute during the past Session, as shown not only in the larger number of classes in Technology registered by the Institute, but also in the increase in the number of students in attendance at such classes, and of candidates for examination. This development is due to the further provision of facilities for technical instruction, and also to the fuller recognition of its value and importance.

The report before us shows that the Institute has endeavoured in various ways to assist this forward movement

Since the Technological Examinations were first undertaken by the Institute, the organisation of technical instruction has been greatly promoted by the Educational Committees of County Councils, with which the Institute has established close relations; and many of the improvements, which have been introduced into its schemes of instruction and examination, have been due